

Decision Rationale

Total Maximum Daily Loads for The Aquatic Life Use Impairment on Russell Prater Creek Buchanan and Dickenson Counties, Virginia

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA's) rationale for approving the TMDLs for the aquatic life use impairment on Russell Prater Creek. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

- 1) The TMDLs are designed to implement applicable water quality standards.
- 2) The TMDLs include a total allowable load as well as individual waste load allocations (WLAs) and load allocations (LAs).
- 3) The TMDLs consider the impacts of background pollutant contributions.
- 4) The TMDLs consider critical environmental conditions.
- 5) The TMDLs consider seasonal environmental variations.
- 6) The TMDLs include a margin of safety (MOS).
- 7) There is reasonable assurance that the TMDLs can be met.
- 8) The TMDLs have been subject to public participation.

II. Background

The Russell Prater Creek Watershed is located in Buchanan and Dickenson Counties in southwestern Virginia. Russell Prater Creek is a tributary to the Russell Fork in the Tennessee/Big Sandy Basin. The benthic impairments on Russell Prater Creek extend 11.27 miles from its headwaters to its mouth. The watershed is heavily mined with forested and mined lands making up 77 and 19 percent of the watershed area respectively.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed Russell Prater Creek (VAS-Q12R) on Virginia's 1996 Section 303(d) list as being unable to attain the general standard due to an aquatic life use impairment identified

through benthic assessments. The stream has remained on the state's subsequent impaired waters lists. To assess the biological integrity of a stream, Virginia uses EPA's Rapid Bioassessment Protocol II (RBPII) to determine status of a stream's benthic macroinvertebrate community.¹ This approach evaluates the benthic macroinvertebrate community between a monitoring site and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.² The state is currently in the process of changing this methodology to a stream condition index (SCI) approach.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological community of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as impaired and are placed on the Section 303(d) list of impaired waters. Russell Prater Creek has had three DEQ benthic assessments conducted since 1997. A moderate impairment was identified in 1997 and 1999. In 2004, the benthic community was assessed as being slightly impaired indicating an improvement in the biological integrity of the system. The SCI assessment method provides very similar results. The area has been intensively mined in the past and these operations continue.

The RBPII analysis assesses the health of the macroinvertebrate community of a stream. The analysis will inform the biologist if the stream's benthic community is impaired. However, it will not inform the biologist as to what is necessarily causing the degradation of the benthic community. Additional analysis may be required to determine the pollutants which are causing the impairment as information can be gleaned based on the composition of the community and the condition of the habitat. TMDL development requires the identification of impairment causes and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.³ Additional water quality data has been collected from Russell Prater Creek as a result of the mining activities and the regulated requirements associated with these dischargers.

A reference watershed approach was used to determine both the stressors and numeric endpoints for the pollutants impacting Russell Prater Creek. Stressors are the pollutants which are impacting the benthic community of the stream. Numeric endpoints represent the water

¹Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

²Ibid 1

³Ibid 1

quality goals that are to be achieved through the implementation of the aquatic life use TMDLs which will allow the impaired water to attain its designated use. A reference watershed approach is based on selecting a non-impaired watershed that shares similar landuse, ecoregion, and geomorphological characteristics with the impaired watershed. The stream conditions and loadings in the reference stream are assumed to be the conditions needed for the impaired stream to attain standards. Therefore, the TMDL intends to replicate the loadings of the reference watershed in the impaired watershed to allow it to attain criteria.

The aquatic life use TMDLs were developed using the Generalized Watershed Loading Function (GWLF) model and Hydrologic Simulation Program Fortran (HSPF) model. There were two pollutants found to be impacting Russell Prater Creek. The HSPF model was used to model the loading of total dissolve solids (TDS) one of the pollutants impacting the stream. The GWLF model was used to model the sediment loading to Russell Prater Creek. The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).⁴ GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.⁵ Calculations are made for sediment based on daily water balance totals that are summed to give monthly values. The HSPF model is a dynamic model that can simulate both watershed loading and receiving water quality over a wide range of conditions.

A reference watershed approach was used to estimate the necessary load reduction needed to restore a healthy aquatic community and allow Russell Prater Creek to achieve its designated uses. Middle River was used as the loading reference watershed to Russell Prater Creek. Middle River was chosen as the loading reference watershed because it was previously assessed as having an impaired benthic community. However, restoration work associated with mining activities in the watershed has allowed Middle River to attain the general standard for the aquatic life use. McClure River was the reference watershed used for the stressor analysis. McClure River is a similar watershed to Middle River and also supports a healthy benthic community. Possible stressors for Russell Prater Creek were evaluated against their observed concentrations in McClure River when numeric criteria were unavailable. Table 1 identifies the TMDL loadings.

⁴Ibid 1

⁵Ibid 1

Table 1 - Summarizes the Specific Elements of the TMDL.

Stream	Pollutant	TMDL	WLA	LA	MOS
Russell Prater Creek	Sediment (Mg/yr)	5,684	40	5,076	568
	TDS (kg/yr)	4,696,400	962,133	3,734,267	Implicit

The United States Fish and Wildlife Service has been provided with a copy of these TMDLs.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing the aquatic life (benthic) use impairment TMDLs for Russell Prater Creek. EPA is therefore approving the TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

As stated above, the biological assessments on Russell Prater Creek were not able to discern a clear stressor to the Creek. The TMDL modelers therefore conducted a stressor identification analysis to determine what was impacting the benthic community. Current ambient water quality data was able to rule out dissolved oxygen (DO), temperature and pH as possible stressors to Russell Prater Creek.

McClure River was used as the reference watershed for the stressor identification study. This 90th percentile of water quality data collected from this unimpaired watershed was used to determine if a pollutant was a stressor. Pollutants that were consistently above the 90th percentile of McClure River were viewed as possible or probable stressors. Metals (iron and manganese) were found in Russell Prater Creek at concentrations well in excess of their 90th percentile concentration in McClure Creek. For some of these stressors, there were no studies documenting their impacts or bioavailability to the benthic community. These pollutants were not identified as possible stressors because Baetidea a metals intolerant family of mayflies was found in high concentrations in the benthic assessments. Based on habitat assessments and water quality data TDS and sediment were determined to be the most probable stressors to Russell Prater Creek.

Habitat assessments conducted with the benthic assessments consistently revealed that the habitat was marginal regarding sediment, with monitoring sites having low embeddedness and pool sediment scores. This documents the filling of habitat used by benthic macroinvertebrates indicating a sedimentation problem exists. Sulfates, TDS, and conductivity were consistently detected at elevated levels, over the 90th percentile of values for McClure Creek. Sulfates are a large component of TDS and controlling TDS will reduce sulfates. TDS is a measure of the concentration of dissolved ions in water which impacts its conductivity.

The GWLF model was used to determine the loading rates of sediment to the impaired and reference streams from all point and nonpoint sources. The TMDL modelers determined the sediment loading rates within each watershed. Data used in the model was obtained on a wide array of items, including land uses in the area, point sources in the watershed, weather, stream geometry, etc..

The GWLF model provides the ability to simulate runoff and sediment loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land). GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.⁶ Local rainfall and temperature data were needed to simulate the hydrology this data was obtained from the National Climatic Data Center (NCDC) station 443640. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of vegetative, land slope, soil erodibility, and land practices used in the area.⁷ Parameters within the model account for these conditions and practices. Although the GWLF model was developed for ungaged watersheds, the model was calibrated to the average daily flows of the HSPF model. Middle Creek was also modeled using the GWLF model for sediment.

To model TDS, the HSPF model was used for both Russell Prater Creek and Middle River. The HSPF model was calibrated to flow data collected throughout the watershed from 1994 through 1999. The model was not validated to a separate set of data. The flow data for the calibration was not from a continuous gage. The water quality model was calibrated to observed water quality data collected at the same time. The endpoint for TDS in Russell Prater Creek was 334 mg/L which is the 90th percentile of TDS concentrations for Middle Creek. It is believed that this concentration will allow for the attainment of a healthy benthic assemblage since Middle Creek is non-impaired. The TSS/sediment loading for Russell Prater Creek was based on the average annual sediment load delivered to Middle Creek as determined by the GWLF model. This model used NCDC station 443640 for weather data.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria and sediment to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be

⁶Ibid 1

⁷Ibid 1

found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There are six National Pollutant Discharge Elimination System (NPDES) permitted facilities identified as discharging sediment to Russell Prater Creek. There are an additional thirty-five mining facilities permitted to discharge sediment and TDS to Russell Prater Creek. The mining operations have surface ponds that collect and treat surface runoff from the mining site. When the mine operation is completed, these ponds are closed and their discharge is ceased. However, new areas may be re-mined and a new pond is created. A runoff event is required for these facilities to discharge to Russell Prater Creek. The current permit for these facilities requires that they discharge sediment in the form of TSS at 70 mg/L or less. The WLA called for no reductions in their current sediment load. None of the mining facilities are currently regulated for TDS. Therefore, their current loading is not known, but a total loading to all of the facilities was provided. It is not known whether the facilities are currently achieving this lumped WLA, but monitoring has been initiated. The WLAs for both sediment and TDS were provided as a lumped load based on the nature of the dischargers. This lumped WLA can not be exceeded by the aggregate of all point sources. Table 2 documents the WLAs and permits.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any NPDES permit that is inconsistent with the WLAs established for that point source.

Table 2 – WLAs for Russell Prater Creek

Source	Pollutant	Load
Transient Mining Operations	TDS	9.62E+05 kg/yr
Transient Mining Operations	Sediment	39 Mg/yr
Virginia Department of Transportation (VAR101807)	Sediment	0.01 Mg/yr
Crooked Branch Highwall Project (VAR103043)	Sediment	0.02 Mg/yr
Russell Prater School (VA0026964)	Sediment	0.497 Mg/yr
Residence (VAG400199)	Sediment	0.083 Mg/yr
Residence (VAG400414)	Sediment	0.083 Mg/yr
Greenbrier Car Wash (VAG750012)	Sediment	0.041 Mg/yr

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings of bacteria, VADEQ used the HSPF model to represent the impaired watersheds. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. HSPF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various land uses within the watershed.

For the sediment TMDL the GWLF model was used to ascertain the sediment loading to Russell Prater Creek and Middle River the reference watershed. The model provides the monthly sediment load to the stream through the use of the universal soil loss equation (USLE). The USLE derives the sediment loading by using information on precipitation rates, best management practices, land slope, and vegetative cover. Tables 3a and b identify the current and TMDL loading for TDS and sediment to Russell Prater Creek.

Table 3a - LA for Sediment for Russell Prater Creek

Source Category	Existing Load (Mg/yr)	Allocated Load (Mg/yr)	Percent Reduction
Barren	4,239	1,519	64
Forest - Disturbed	3,858	1,382	64
Forest - Undisturbed	949	949	0.00
Pasture - Hay	2	2	0.00
Pasture - Over Grazed	137	137	0.00
Pasture - Improved	19	19	0.00
Abandoned Mining	1,369	490	64
Residential - Pervious	1	1	0.00
High - Tillage	432	432	0.00
Low - Tillage	133	133	0.00
Wetlands	1	1	0.00
Uncontrolled Dischargers	33	0	100

Table 3b – LA for TDS for Russell Prater Creek

Source Category	Proposed Load
Nonpoint Sources	8.52E+06 kg/yr

3) The TMDLs consider the impacts of background pollution.

The TMDL considers the impact of background pollutants by considering the sediment and TDS loadings from background sources like forested lands and calibrating the model to observed conditions.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Russell Prater Creek is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards⁸. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The HSPF and GWLF models were run over a multi-year period to insure that they accounted for a wide range of climatic conditions. The allocations developed in these TMDLs will therefore insure that the criteria are attained over a wide range of environmental conditions including wet and dry weather conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with the discussion

⁸EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

regarding critical conditions, the HSPF and GWLF models and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and by modifying waste application rates, crop cycles, and livestock practices.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia included an implicit MOS in the TDS TMDLs through the use of Middle River for their reference watershed. An explicit 10 percent MOS was used for the sediment TMDL.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDLs have been subject to public participation.

During the development of the TMDLs for the Russell Prater Creek Watershed, public involvement was encouraged through several meetings to discuss and disseminate the TMDL. A basic description of the TMDL process and the agencies involved was presented at the first public meeting on August 19, 2004 at Haysi Town Hall in Haysi, Virginia with 24 people in attendance. The second and final public meeting was held on January 11, 2005 at the Russell Prater Elementary School in Prater, Virginia. Forty-one people attended the final public meeting. Both meetings were subject to a thirty-day comment period. Notices were sent out to local residents informing them of the meetings. Three comments were received during the comment period for the second public meeting.